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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/044,468	SHARMA ET AL.	
	Examiner	Art Unit	
	James A. Thompson	2625	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 May 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *2-4,7-24 and 28-36* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *2-4,7-24 and 28-36* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 27 May 2009 have been fully considered but they are not persuasive.

Regarding page 10, lines 1-14: Applicant's amendments to the claims and newly added claims have been fully considered and are addressed below in the rejections and notice of allowable subject matter.

Regarding page 10, lines 16-32: Applicant's amendments to the method claims do not satisfy the requirements of 35 U.S.C. § 101. Reciting that the method is a method of halftoning by an image processing unit does not tie the method to a particular machine, but rather only shows the intended field of use. The amended preamble of the independent method claims do not provide meaningful limits to the scopes of the method claims.

Applicant's arguments in the Appeal Brief of 21 May 2007 have already been fully addressed by Examiner in the Examiner's Answer of 31 March 2009. Applicant's present amendments to the claims have been fully considered and are fully addressed below.

Claim Rejections - 35 USC § 101

2. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claims 2-4, 7-24 and 32-36 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

Supreme Court precedent[1] and recent Federal Circuit decisions[2] indicate that a statutory "process" under 35 U.S.C. 101 must (1) be tied to another statutory category (such as a particular apparatus), or (2) transform underlying subject matter (such as an article or material) to a different state or thing.

Independent claim 4 recites a method that is not tied to a particular apparatus, or otherwise tied to another statutory category. Said method also does not transform any underlying subject matter to a different state or thing. Claim 4 is simply a method of manipulating data, specifically halftone image data. While the method recited in claim 4 may be for the purpose of rendering an image, rendering is not specifically recited as a step. Further, said method relates generally to the idea of minimizing the number of passes needed to render a tone in a multi-pass printer. Thus, claim 4 attempts to preempt the idea itself, rather than restricting itself to the particular method disclosed by Appellant.

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[1] *Diamond v. Diehr*, 450 U.S. 175, 184 (1981); *Parker v. Flook*, 437 U.S. 584, 588 n.9 (1978); *Gottschalk v. Benson*, 409 U.S. 63, 70 (1972); *Cochrane v. Deener*, 94 U.S. 780, 787-88 (1876).

[2] *In re Bilski*, 88 USPQ2d 1385 (Fed. Cir. 2008).

Additionally, the recitation in claim 4 that the method is a "method of halftoning by an image processing unit" merely shows the intended field of use. It does not provide meaningful limits on the claim's scope. Finally, claims 2, 3, 7-14 and 32-34 each ultimately depend from claim 4 and are therefore also rejected under 35 U.S.C. § 101.

Independent claims 15 and 20 are also rejected under 35 U.S.C. § 101 for the reasons provided with respect to claim 4. Claims 16-19 and 35 each ultimately depend from claim 15 and are therefore also rejected under 35 U.S.C. § 101. Claims 21-24 and 36 each ultimately depend from claim 20 and are therefore also rejected under 35 U.S.C. § 101.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claim 28 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claim 28 recites only a single means for performing the desired function, and is therefore subject to rejection under 35 U.S.C. § 112, first paragraph as having undue breadth. See MPEP § 2164.08(a); *In re Hyatt*, 708 F.2d 712, 714-715, 218 USPQ 195, 197 (Fed. Cir. 1983). Claim 28 covers every conceivable way of performing the desired function, and not merely the ways disclosed by Applicant. Therefore, claim 28 is not enabled by Applicant's specification.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the

> United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claim 28 is rejected under 35 U.S.C. 102(e) as being anticipated by Gotoh (US-2002/0024548).

Regarding claim 28: Gotoh discloses a system (figure 16 and para. 49 of Gotoh) comprising means for restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (para. 71, lines 5-9 of Gotoh). In the example given, half of the turned-on pixels are printed in two passes (para. 71, lines 5-9 of Gotoh). Thus, only one-quarter of the turned-on pixels are printed in a single pass. Therefore, three-quarters of the turned-on pixels are restricted from being printed.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 2-4, 7-10 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gotoh (US-2002/0024548) in view of Wang (US-6,014,500).

Regarding claim 4: Gotoh discloses a method of halftoning by an image processing unit (IPU) (para. 108 of Gotoh), comprising: generating a screen pixel turn-on sequence of turn-on sequence values representing the turn-on sequence order for corresponding image pixels (figure 26 and para. 79-80 of Gotoh); partitioning the screen pixel turn-on sequence into a plurality of partitions (figure 21C; figure 26(8B,8C); and para. 80 of Gotoh), wherein each partition corresponds to a different pass of a multi-pass printer used in printing the image (para. 72, lines 4-7 and para. 81 of Gotoh); re-ordering the screen pixel turn-on sequence (para. 80 of Gotoh) to restrict a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (figure 21C and para. 71, lines 5-9 of Gotoh - *by switching blocks of the gray scale pattern [para. 80 of Gotoh], the screen pixel turn-on sequence is re-ordered*); and generating a halftone screen (figure 26 of Gotoh) using the re-ordered screen pixel turn-on sequence (para. 79-80 of Gotoh - *the gray scale patterns [figure 26 of Gotoh] are halftone screens since they are used to determine which dots are printed for a corresponding gray level value*).

Gotoh does not disclose expressly that said screen pixel turn on sequence is specifically a stochastic screen pixel turn on sequence.

Wang discloses generating a stochastic screen pixel turn-on sequence (column 5, lines 52-56 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically generate a stochastic screen pixel turn-on sequence, as taught by Wang. The suggestion for doing so would have been that stochastic screens provide the highest resolutions at all possible levels with all possible orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 4.

Regarding claim 2: Gotoh discloses that the substantial majority is approximately 75% or more of the pixels turned on to render a tone (para. 71, lines 5-9 of Gotoh - *In the example given, half of the turned-on pixels are printed in two passes [para. 71, lines 5-9 of Gotoh]. Thus, only one-quarter of the turned-on pixels are printed in a single pass. Therefore, three-quarters of the turned-on pixels are restricted from being printed.*).

Regarding claim 3: Gotoh discloses that the substantial majority is approximately 90% or more of the pixels turned on to render a tone (para. 72, lines 5-9 and para. 73, lines 4-9 of Gotoh - *In the case of 64 nozzles, only 1.5625% of the turned-on pixels are printed with a single nozzle. Thus, more than 90% of the turned-on pixels are restricted from being printed so that,*

with two sets of 32 nozzles [para. 73, lines 4-9 of Gotoh], a tone can be rendered in the minimum number of passes.).

Regarding claim 7: Gotoh does not disclose expressly that the re-ordering step including placing the lowest stochastic screen pixel turn-on sequence values in one partition and the highest stochastic screen pixel turn-on values in another partition.

Wang discloses placing the lowest stochastic screen pixel turn-on sequence values in one partition and the highest stochastic screen pixel turn-on values in another partition (column 7, lines 30-40 of Wang). The stochastic screen pixel turn-on sequence values are partitioned into checkerboard and reverse-checkerboard partitions (column 7, lines 30-40 of Wang). Since first half (S_1) turn-on sequence is in checkerboard form, then the first partition must be the lowest stochastic screen pixel turn-on sequence values and the second half (S_2) must be the highest stochastic screen pixel turn-on sequence values.

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically generate a stochastic screen pixel turn-on sequence in the partitioning order taught by Wang. The suggestion for doing so would have been that the stochastic screens taught by Wang provide the highest resolutions at all

possible levels with all possible orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 7.

Regarding claim 8: Gotoh discloses that a checkerboard pattern is used for printing the individual pixels of the first partition, and then a reverse checkerboard pattern is used for printing the individual pixels of the second partition (figure 21C and para. 72, lines 9-19 of Gotoh).

Gotoh does not disclose expressly (a) replacing the lowest stochastic screen pixel turn-on value before re-ordering contained in one partition with a replacement value which is the lowest stochastic screen pixel turn-on sequence value of all partitions of the screen; (b) replacing the next lowest stochastic screen pixel turn-on value in the one partition with a replacement value which is the next lowest stochastic screen pixel turn-on sequence value of all partitions of the screen; (c) repeating step (b) until the one partition is filled with the lowest stochastic screen pixel turn-on sequence values of all partitions; and (d) repeating steps (a) through (c) to re-order each of the other partitions in turn with the remaining unused replacement values.

Wang discloses re-ordering the stochastic screen pixel turn-on values (column 5, lines 52-61 of Wang) to optimize a merit function and thus minimize the level of moiré (column 7, lines

44-55 of Wang) based on a checkerboard pattern (column 7, lines 28-34 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to re-order the stochastic screen pixel turn-on sequence values according to a checkerboard pattern, as taught by Wang, based specifically on the ordering of the checkerboard pattern (partition 1) and inverted checkerboard pattern (partition 2) taught by Gotoh. Since the pattern (figure 21C of Gotoh) prints in an order of alternating dots, the reordering performed according to the teachings of Wang (column 5, lines 52-61 of Wang) would be performed to produce the same pattern (figure 21C of Gotoh; and column 7, lines 28-34 of Wang). Thus, the re-ordering would be performed such that (a) the lowest stochastic screen pixel turn-on value is replaced before re-ordering contained in one partition with a replacement value which is the lowest stochastic screen pixel turn-on sequence value of all partitions of the screen; (b) the next lowest stochastic screen pixel turn-on value is replaced in the one partition with a replacement value which is the next lowest stochastic screen pixel turn-on sequence value of all partitions of the screen; (c) step (b) is repeated until the one partition is filled with the lowest stochastic screen pixel turn-on sequence values of all partitions; and (d) steps (a) through (c) are repeated to re-

order each of the other partitions in turn with the remaining unused replacement values. The motivation for doing so would have been that the optimization taught by Wang eliminates moiré between the input and the screen (column 7, lines 25-30 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 8.

Regarding claim 9: Gotoh discloses that a checkerboard pattern is used for printing the individual pixels of the first partition, and then a reverse checkerboard pattern is used for printing the individual pixels of the second partition (figure 21C and para. 72, lines 9-19 of Gotoh).

Gotoh does not disclose expressly (a) obtaining a subsequence for each partition by arranging the pixels within the partition in increasing order of turn-on sequence values; (b) concatenating the subsequences for the different partitions, in any order, to form a single sequence; and (c) renumbering the resulting single sequence in increasing order of turn-on values to obtain the new turn-on sequence.

Wang discloses re-ordering the stochastic screen pixel turn-on values (column 5, lines 52-61 of Wang) to optimize a merit function and thus minimize the level of moiré (column 7, lines 44-55 of Wang) based on a checkerboard pattern (column 7, lines 28-34 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it

would have been obvious to a person of ordinary skill in the art to re-order the stochastic screen pixel turn-on sequence values according to the order of the checkerboard pattern (partition 1) and inverted checkerboard pattern (partition 2), as taught by Wang, based specifically on the ordering of the checkerboard pattern taught by Gotoh. Since the pattern (figure 21C of Gotoh) prints in a specific order with respect to each partition, the re-ordering performed according to the teachings of Wang (column 5, lines 52-61 of Wang) would be performed to produce the same pattern (figure 21C of Gotoh; and column 7, lines 28-34 of Wang). Thus, the re-ordering would be performed by (a) obtaining a subsequence for each partition by arranging the pixels within the partition in increasing order of turn-on sequence values; (b) concatenating the subsequences for the different partitions, in any order, to form a single sequence; and (c) renumbering the resulting single sequence in increasing order of turn-on values to obtain the new turn-on sequence. The motivation for doing so would have been that the optimization taught by Wang eliminates moiré between the input and the screen (column 7, lines 25-30 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 9.

Regarding claim 10: Gotoh discloses partitioning the screen pixel turn-on sequence into two partitions (figure 26 (8B,8C) and para. 79-80 of Gotoh).

As demonstrated in the arguments regarding claim 4, combining the teachings of Wang with Gotoh provides for the

halftone screen taught by Gotoh being specifically a stochastic halftone screen.

Regarding claim 29: Gotoh discloses a screen pixel turn-on sequence generator (figure 26 and para. 79-80 of Gotoh); and means for partitioning the screen pixel turn-on sequence into a plurality of partitions (figure 21C; figure 26(8B,8C); and para. 80 of Gotoh) each partition corresponding to a different pass (para. 72, lines 4-7 and para. 81 of Gotoh), wherein the restricting means includes means for re-ordering the screen pixel turn-on sequence (para. 80 of Gotoh) to restrict a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (figure 21C and para. 71, lines 5-9 of Gotoh). By switching blocks of the gray scale pattern (para. 80 of Gotoh), the screen pixel turn-on sequence is re-ordered.

Gotoh does not disclose expressly that said screen pixel turn on sequence is specifically a stochastic screen pixel turn on sequence.

Wang discloses generating a stochastic screen pixel turn-on sequence (column 5, lines 52-56 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically generate a stochastic screen pixel turn-on sequence, as taught by Wang. The suggestion for doing so would

have been that stochastic screens provide the highest resolutions at all possible levels with all possible orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 29.

10. Claims 11-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gotoh (US-2002/0024548) in view of Wang (US-6,014,500) and obvious engineering design choice.

Regarding claim 11: Gotoh does not disclose expressly that the partitions are designated S_1 and S_2 and the merit function is $\widetilde{M}(S)=M(S)+w_1*M(S_1)+w_2*M(S_2)$, where $M(S)$ is a merit function suitable for a single stochastic screen and w_1 and w_2 are weighting factors in the range of 2 to approximately 100.

Wang discloses that the partitions are designated S_1 and S_2 and the merit function is $\widetilde{M}(S)=M(S)+w_1*M(S_1)+w_2*M(S_2)$, where $M(S)$ is a merit function suitable for a single stochastic screen (column 7, lines 42-53 of Wang) and w_1 and w_2 are weighting factors (column 7, lines 54-55 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the specific merit function taught by Wang. The

suggestion for doing so would have been that the stochastic screens taught by Wang provide the highest resolu-tions at all possible levels with all possible orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh.

Gotoh in view of Wang does not disclose expressly that the weighting factors are in the range of 2 to approximately 100. However, it would have been an obvious engineering design choice to set the weighting factors in the range of 2 to approximately 100. Firstly, the weighting factors are set for the purpose of balancing the overall quality and moiré removal (column 7, lines 54-55 of Wang). Secondly, the exact weighting values depend, at least in part, on how the function $M(S)$ is specifically defined. Setting the weighting values to 3 or 0.3 or 0.0003 or 300000 (for example) depends upon factors such as how the density values are expressed, the range of the density values, and the physical units applied when using the equation to obtain a specific result. Thus, setting the weighting values would simply be an operation that one of ordinary skill in the art at the time of the invention would perform for the purpose of practicing the system set forth by Gotoh in view of Wang. Therefore, it would have been obvious to implement the obvious engineering design choice in the system of Gotoh in view of Wang to obtain the invention as specified in claim 11.

Further regarding claim 12: Wang discloses that the partitioning step includes partitioning into a checkerboard partition arrangement (column 7, lines 25-30 of Wang).

Further regarding claim 13: Wang discloses generating a halftone screen for a checkerboard partition (column 7, lines 25-30 of Wang) such that the pixels can be classified as belonging to the two partitions using the coordinates of columns and rows, i and j, and the mathematical rule $p(i,j) \in S_1, if(i,j)\%2 = 0$; $p(i,j) \in S_2, if(i,j)\%2 = 1$; $S = S_1 + S_2$ (column 7, lines 30-41 of Wang) and optimizing the merit function $\widetilde{M}(S) = M(S) + w_1 * M(S_1) + w_2 * M(S_2)$, where w_1 and w_2 are weighting factors (column 7, lines 44-55 of Wang).

As discussed above in the arguments regarding claim 11, it would have been an obvious design choice to set w_1 and w_2 in the range of 2 to approximately 100.

Regarding claim 14: Gotoh in view of Wang does not disclose expressly that $w_1 \approx 3$ and $w_2 \approx 3$. However, it would have been an obvious engineering design choice to set the weighting factors such that $w_1 \approx 3$ and $w_2 \approx 3$. Firstly, the weighting factors are set for the purpose of balancing the overall quality and moiré removal (column 7, lines 54-55 of Wang). Secondly, the exact weighting values depend, at least in part, on how the function $M(S)$ is specifically defined. Setting the weighting values to 3 or 0.3 or 0.0003 or 300000 (for example) depends upon factors such as how the density values are expressed, the range of the

density values, and the physical units applied when using the equation to obtain a specific result. Thus, setting the weighting values would simply be an operation that one of ordinary skill in the art at the time of the invention would perform for the purpose of practicing the system set forth by Gotoh in view of Wang. Therefore, it would have been obvious to implement the obvious engineering design choice in the system of Gotoh in view of Wang to obtain the invention as specified in claim 14.

11. Claims 15-24 and 30-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gotoh (US-2002/0024548) in view of Shiau (US-5,880,857).

Regarding claim 15: Gotoh discloses a method of halftoning by an image processing unit (IPU) (para. 108 of Gotoh), comprising: providing an input image having a plurality of pixels each having an input tone value (para. 61, lines 7-10 of Gotoh); partitioning the input image pixels into partitions (figure 21C; figure 26(8B, 8C); and para. 80 of Gotoh) wherein each partition corresponds to a different pass of multi-pass printing (para. 72, lines 4-7 and para. 81 of Gotoh); and processing the input image pixels on a pixel-by-pixel basis restricting a substantial majority of the pixels turned on to render a tone in the image to the minimum number of passes required to produce the tone (figures 19A-19C; and para. 71 of Gotoh - *In the example given, half of the turned-on pixels are printed in two passes [para. 71,*

lines 5-9 of Gotoh]. Thus, only one-quarter of the turned-on pixels are printed in a single pass. Therefore, three-quarters of the turned-on pixels are restricted from being printed.).

Gotoh does not disclose expressly that said input image pixels are processed on a pixel-by-pixel basis *using error diffusion halftoning*; adding a zero mean bias signal to each input image pixel tone value based on the partition containing the input image pixel; adding an error diffused from previously processed pixels to the input tone value of each input image pixel being processed to achieve a desired pixel value for the pixel; and comparing the desired pixel value of each pixel being processed with a threshold value to turn on or not turn on each pixel for rendering the image.

Shiau discloses that the input image pixels are processed on a pixel-by-pixel basis using error diffusion halftoning (column 4, lines 18-20 of Shiau); adding a zero mean bias signal to each input image pixel tone value based on the partition containing the input image pixel (column 3, lines 62-66 and column 5, lines 11-19 of Shiau - *since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias*); adding an error diffused from previously processed pixels to the input tone value of each input image pixel being processed to achieve a desired pixel value for the pixel (column 4, lines 18-20 of Shiau); and comparing the

desired pixel value of each pixel being processed with a threshold value to turn on or not turn on each pixel for rendering the image (column 4, lines 9-17 of Shiau).

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random values with a zero mean bias, as taught by Shiau. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claim 15.

Regarding claim 20: Gotoh discloses a method of halftoning by an image processing unit (IPU) (para. 108 of Gotoh), comprising: providing an input image having a plurality of pixels each having an input tone value (para. 61, lines 7-10 of Gotoh); partitioning the input image pixels into partitions (figure 21C; figure 26(8B, 8C); and para. 80 of Gotoh) wherein each partition corresponds to a different pass of multi-pass printing (para. 72, lines 4-7 and para. 81 of Gotoh); and processing the input image pixels on a pixel-by-pixel basis restricting a substantial majority of the pixels turned on to render a tone in the image to the minimum number of passes required to produce the tone (figures 19A-19C; and para. 71 of Gotoh - *In the example given, half of the turned-on pixels are printed in two passes [para. 71,*

lines 5-9 of Gotoh]. Thus, only one-quarter of the turned-on pixels are printed in a single pass. Therefore, three-quarters of the turned-on pixels are restricted from being printed.).

Gotoh does not disclose expressly that said input image pixels are processed on a pixel-by-pixel basis *using error diffusion halftoning*; adding a zero mean bias signal to each input image pixel tone value based on the partition containing the input image pixel; adding an error diffused from previously processed pixels to the input tone value of each input image pixel being processed to achieve a desired pixel value for the pixel; and comparing the desired pixel value of each pixel being processed with a threshold value to turn on or not turn on each pixel for rendering the image.

Shiau discloses that the input image pixels are processed on a pixel-by-pixel basis using error diffusion halftoning (column 4, lines 18-20 of Shiau); adding an error diffused from previously processed pixels to the input tone value of each input image pixel being processed to achieve a desired pixel value for the pixel (column 4, lines 18-20 of Shiau); and comparing the desired pixel value of each pixel being processed with a threshold value added to a zero mean bias signal to turn on or not turn on each pixel for rendering the image, wherein the zero mean bias signal has a value based on the partition containing the pixel being processed (column 3, lines 62-66; column 4, lines 9-17; and column 5, lines 11-19 of Shiau - *since the generated random noise added to the tone level has a random value between*

plus and minus 255 for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias).

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random values with a zero mean bias, as taught by Shiau. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claim 20.

Regarding claims 16 and 21: Gotoh discloses partitioning the input image pixels into two partitions (figure 26(8B,8C) and para. 79-80 of Gotoh).

Regarding claims 17-18 and 22-23: Gotoh discloses partitioning the input image pixels into a checkerboard partition (figure 21 and para. 72, lines 9-13 of Gotoh).

Gotoh does not disclose expressly that the zero mean bias signal has a value of +D for one partition and –D for the other partition.

Shiau discloses that the zero mean bias signal has a value of +D (e.g. +20) for a first section of input data and –D (e.g. –20) for a second section of input data (column 8, lines 15-25 of Shiau).

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a bias of +D for one partition and a bias of -D for another partition, as taught by Shiau. The motivation for doing so would have been to be able to properly apply the correct amount of perturbing noise (column 8, lines 50-55 of Shiau), thus helping to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claims 17-18 and 22-23.

Further regarding claims 19 and 24: Shiau discloses that the input image tone value can be one of 256 values (0 to 255) (column 7, lines 25-29 of Shiau) and the value of D is between approximately 32 and 64 (column 5, lines 15-26 of Shiau). For the case of a grey value of 85, the coefficient is 0.5. Therefore, for a random noise value of plus or minus 128, the value of D is 64, and for a random noise value of plus or minus 64, the value of D is 32.

Regarding claim 30: Gotoh discloses means for partitioning an input image having a plurality of input pixel tone values (para. 61, lines 7-10 of Gotoh) into a plurality of partitioned pixel tone values (figure 21C; figure 26(8B,8C); and para. 79-80 of Gotoh).

Gotoh does not disclose expressly means for processing the partitioned pixel tone values to produce a previously processed pixel error diffusion value; means for processing a current partitioned input pixel tone value including means for adding the previously processed pixel error diffusion value to the current partitioned input pixel tone value to achieve a desired pixel value; and means for comparing the desired pixel value with a threshold value to produce an output signal for rendering the image, wherein the means for restricting includes means for adding a zero mean bias signal being based on the partition containing the partitioned pixel tone value.

Shiau discloses means for processing pixel tone values to produce a previously processed pixel error diffusion value (column 4, lines 18-20 of Shiau); means for processing a current input pixel tone value including means for adding the previously processed pixel error diffusion value to the current input pixel tone value of a current pixel to achieve a desired pixel value (column 4, lines 18-20 of Shiau); and means for comparing the desired pixel value with a threshold value (column 4, lines 9-13 of Shiau) to produce an output signal for rendering the image (column 4, lines 12-18 of Shiau), wherein the means for restricting includes means for adding a zero mean bias signal being based on the partition containing the partitioned pixel tone value (column 3, lines 62-66 and column 5, lines 11-19 of Shiau - *since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential*

gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias).

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random values with a zero mean bias, as taught by Shiau, to the partitions taught by Gotoh. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claim 30.

Regarding claim 31: Gotoh discloses means for partitioning an input image having a plurality of input pixel tone values (para. 61, lines 7-10 of Gotoh) into a plurality of partitioned pixel tone values (figure 21C; figure 26(8B,8C); and para. 79-80 of Gotoh).

Gotoh does not disclose expressly means for processing the partitioned pixel tone values to produce a previously processed pixel error diffusion value; means for processing a partitioned input pixel tone value including means for adding the previously processed pixel error diffusion value to the partitioned input pixel tone value to achieve a desired pixel value; and means for comparing the desired pixel value with a threshold value to

produce an output signal for rendering the image, wherein the means for restricting includes means for adding a zero mean bias signal to the threshold value, the zero mean bias signal being based on the partition containing the partitioned pixel tone value.

Shiau discloses means for processing pixel tone values to produce a previously processed pixel error diffusion value (column 4, lines 18-20 of Shiau); means for processing an input pixel tone value including means for adding the previously processed pixel error diffusion value to the input pixel tone value of a current pixel to achieve a desired pixel value (column 4, lines 18-20 of Shiau); and means for comparing the desired pixel value with a threshold value (column 4, lines 9-13 of Shiau) to produce an output signal for rendering the image (column 4, lines 12-18 of Shiau), wherein the means for restricting includes means for adding a zero mean bias signal to the threshold value (column 3, lines 62-66 and column 4, lines 30-34 of Shiau), the zero mean bias function being based on the partition containing the partitioned pixel tone value (column 5, lines 11-19 of Shiau - *since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias*).

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and

halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random values with a zero mean bias, as taught by Shiau, to the partitions taught by Gotoh. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claim 31.

Allowable Subject Matter

12. Claims 32-36 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, and if the rejections under 35 U.S.C. 101 are successfully resolved.

The following is a statement of reasons for the indication of allowable subject matter:

Claims 32, 35 and 36 depend from independent claims 4, 15 and 20, respectively. Claims 4, 15 and 20 each recite method for multi-pass printing which include various ways of halftone screening so as to render pixels in a minimum number of passes. Claims 32, 35 and 36 further limit their respective methods by requiring that the image being halftoned includes image

highlights and image shadows and the processing of the input image pixels on a pixel-by-pixel basis using error diffusion halftoning restricts pixels in the image highlights turned on for printing to one of the partitions and pixels in the image shadows not turned on for printing to another one of the partitions. Examiner has not found this particular combination of features in the prior art. Therefore, claims 32, 35 and 36 are deemed to potentially contain allowable subject matter if the rejection under 35 U.S.C. 101 is successfully resolved.

Claim 33 depends from independent claim 4. Claim 33 further limits the method of claim 4 by requiring that the partitioning step includes partitioning the stochastic screen pixel turn-on sequence into four partitions for four-pass printing and the re-ordering places a substantial majority of the lowest pixel turn-on values in the first partition, a substantial majority of the next lowest pixel turn-on values in a second partition, and a substantial majority of the highest pixel turn-on values in the fourth partition. Examiner has not found this particular combination of features in the prior art. Therefore, claim 33 is deemed to contain allowable subject matter if the rejection under 35 U.S.C. 101 is successfully resolved. Claim 34 depends from claim 33, and is therefore also deemed to contain allowable subject matter.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A. Thompson whose telephone number is (571)272-7441. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Edward L. Coles can be reached on 571-272-7402. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/James A Thompson/
Primary Examiner
Art Unit 2625

07 July 2009